Space Weather Technical Forecast

Issued on Tuesday 25 March 2025 at 13:01 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor to G2/Moderate geomagnetic storms throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with occasional C-flares. The largest flare was most likely from AR4030 in the southwest, reaching C9.5 at 25/1229 UTC. There are currently six sunspot regions on the Earth-facing disc, all of which are small and magnetically simple. AR4036, approaching the northwest limb, remains the largest group. A new spot has emerged around the northeast limb, this appears to have numerous spots and is small to moderate in size.

No Earth-directed CMEs were observed leaving the Sun during the period.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by DSCOVR at L1, saw the solar wind speeds initially at slightly elevated levels, 430km/s, gradually easing to slow-ambient wind speeds, at around 370km/s. Density was above average at 16ppcc falling to average from around 24/2000 UTC before then showing a slight increase from 25/0900 UTC to just above average, peaking at 11ppcc. The Interplanetary Magnetic Field, Bt, had some brief weak intervals before 24/2100 UTC before becoming steadily moderate, with a peak at 9nT. The north-south component, Bz, remained weak and variable in direction, ranging between -8nT at 25/0659 UTC and +7nT at 25/0934 UTC. The phi angle was mostly towards the sun (negative). Geomagnetic activity was at Quiet to Unsettled levels (Kp2-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was at background to moderate levels. The 24-hour fluence was below the Active threshold. The observed integrated pfu was 3.77e6 at 25/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low solar activity is expected, with a slight chance of isolated M-class flares over the next four days of the guidance period.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs in the forecast, with the main driver for any enhanced geomagnetic activity likely to be from the HSS originating from CH25+. Solar winds are expected to continue at slow-ambient levels to start before probably

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becoming elevated to strong levels with the expected arrival of the HSS from CH25/+ from later day 1 (25 Mar), lasting through day 2 into day 3 (26-27 Mar), then gradually easing day 4 (28 Mar).

Quiet conditions initially will probably become Unsettled to Active (Kp3-4), with an increasing Chance of G1-G2/Minor-Moderate storms (Kp5-6) due to CH HSS influences, peaking day 2 or day 3 (26/27 Mar) before easing day 4 (28 Mar).

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a only a very slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at largely background to moderate levels until later in the period, when it may become diurnally high. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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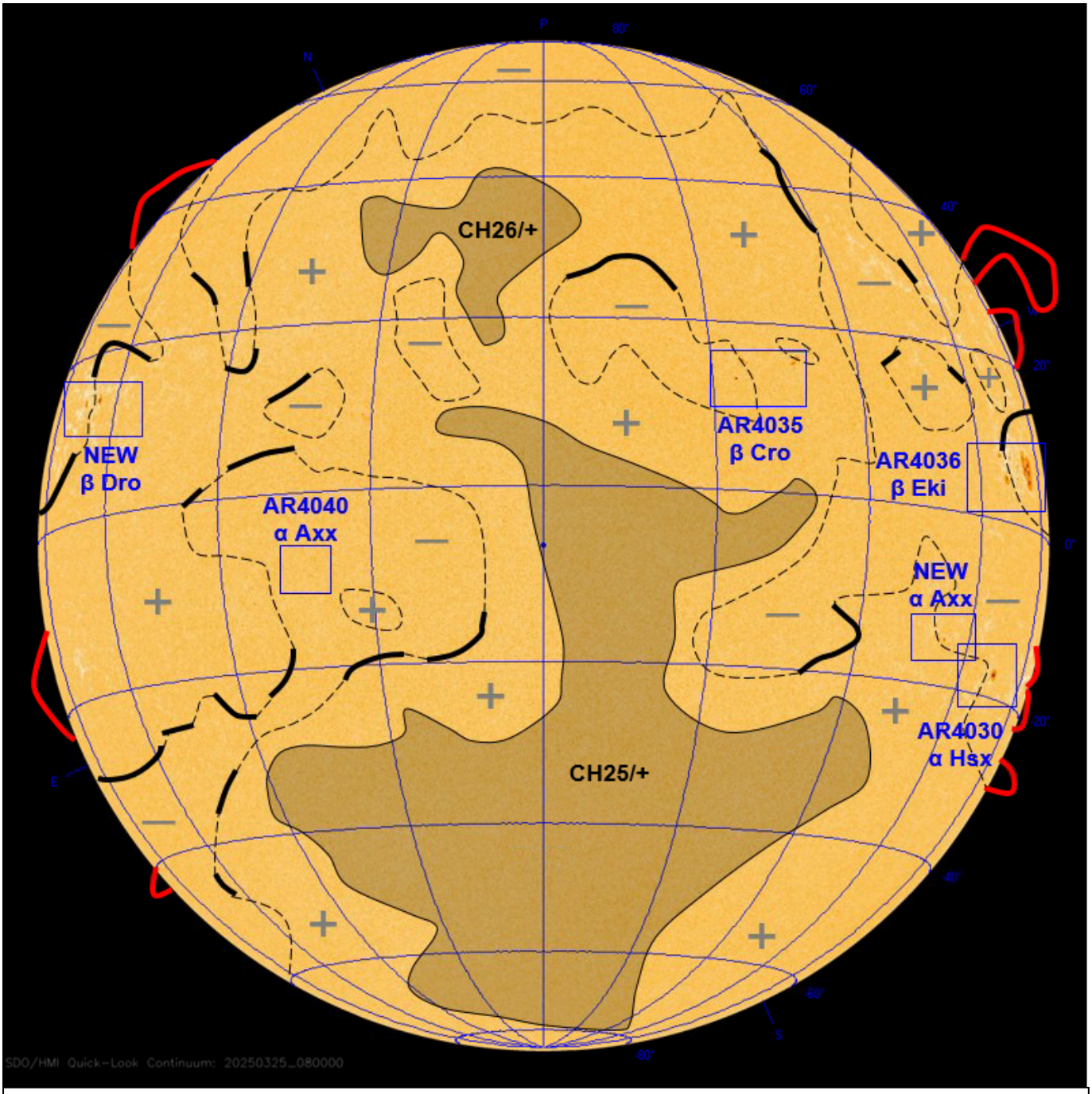
Figure 1: Solar Synoptic Map valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs in the forecast at present.

Solar winds are expected to continue at slow-ambient levels to start before gradually increasing to become enhanced by the end of day 1 (25 Mar), reaching elevated to strong levels by day 2 (26 Mar) with the expected arrival of a HSS from the unusually prominent coronal hole feature, CH25/+. The enhanced geomagnetic activity from the HSS is likely to persist through much of the period, before beginning to gradually ease by day 4 (28 Mar). During the previous rotation solar winds exceeded 700 km/s for a time. Both the MOSWOC Enlil output and SWPM are likely providing good guidance on potential wind speeds through the period given a similar structure to this coronal hole was observed on last rotation.

Quiet conditions initially will probably become Unsettled to Active (Kp3-4), with an increasing Chance of G1-G2/Minor-Moderate storms due to CH HSS influences, peaking day 2 or day 3 (26/27 Mar) before easing day 4 (28 Mar).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	50	50	30
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: MOSWOC Enlil output showing the onset of the HSS from CH25+ later on 25 Mar and mainly on 26 Mar.

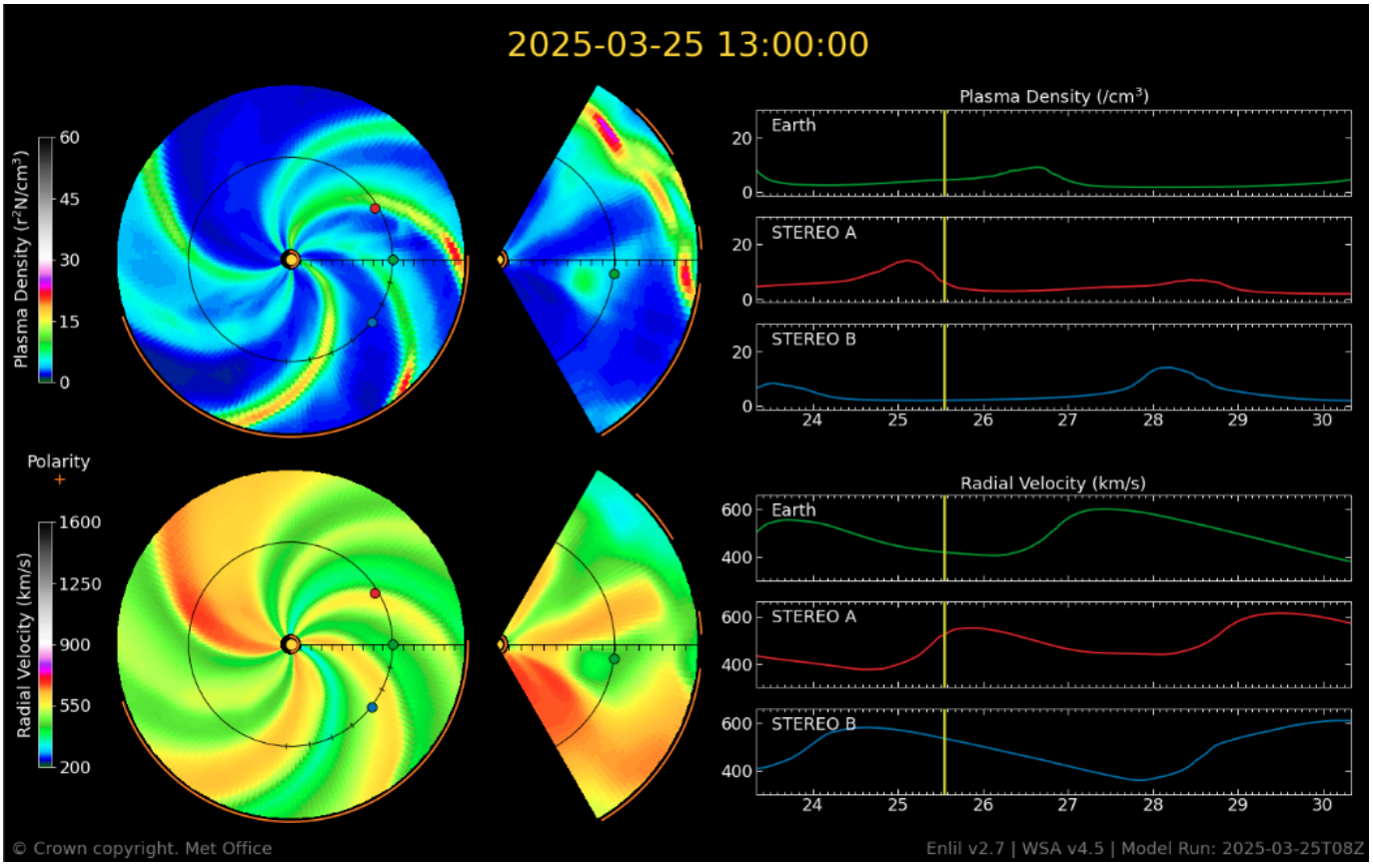

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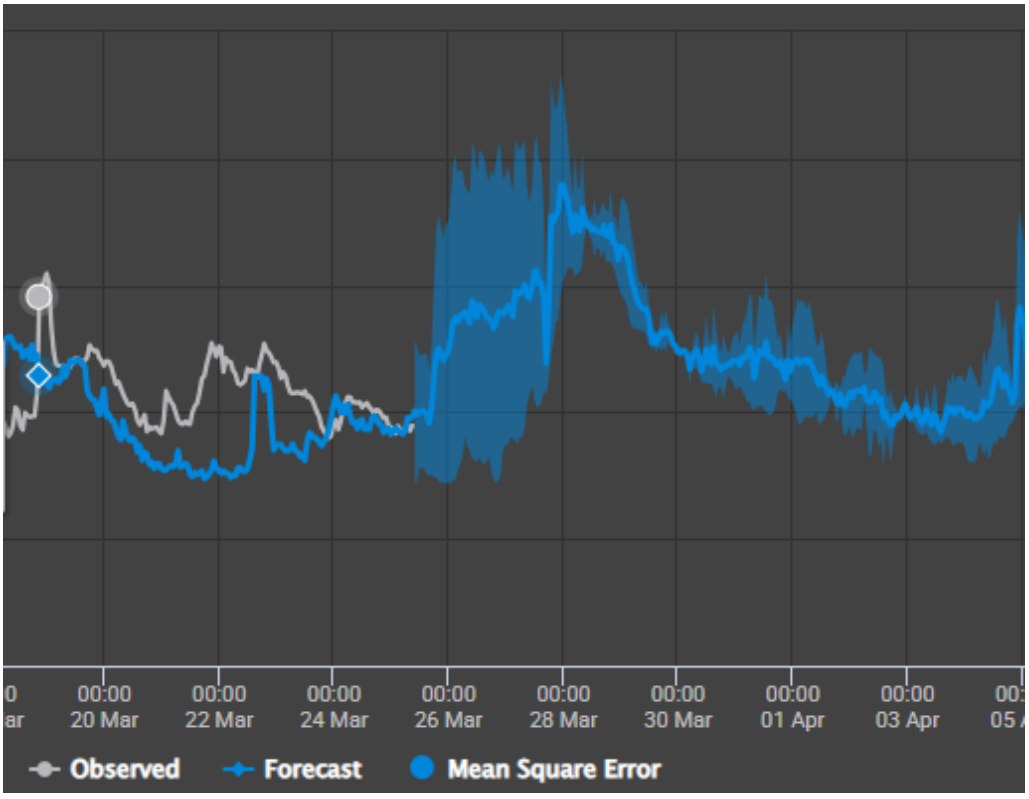
Figure 3: MOSWOC SWPM output showing the persistence forecast for the arrival of the CH25+, with solar wind speeds peaking above 700km/s.



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Radio Blackouts - X-Ray Flares

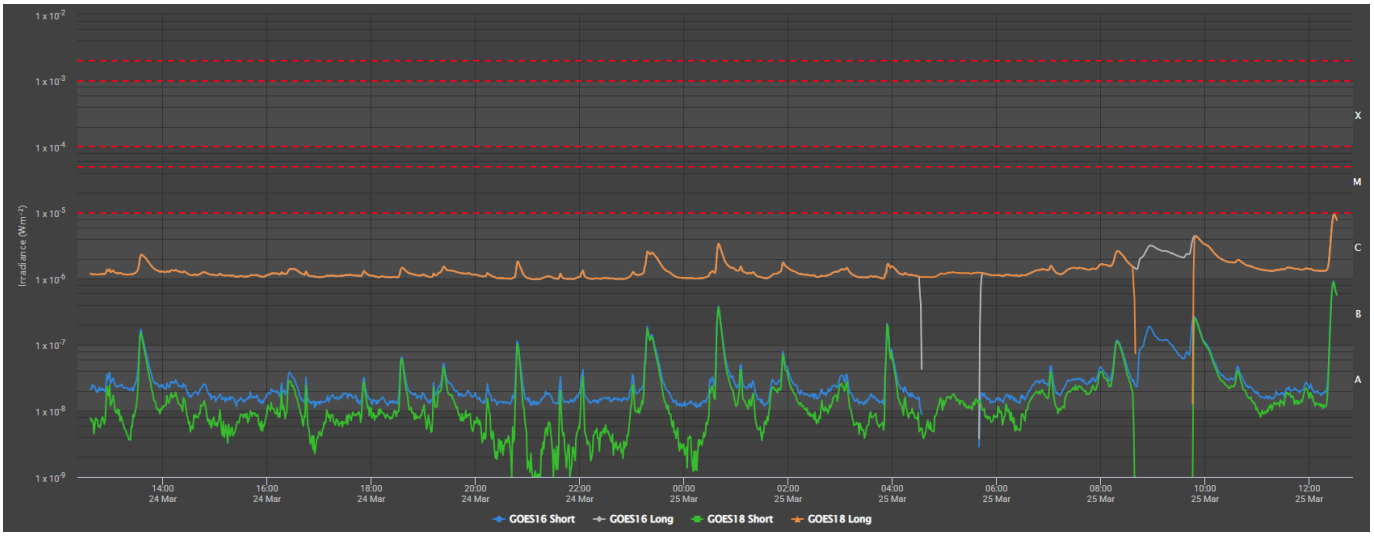
Solar activity has been Low in the past 24 hours, with occasional C-flares. The largest flare was most likely from AR4030 in the southwest, reaching C9.5 at 25/1229 UTC.

There are currently six sunspot regions on the Earth-facing disc. All of which are small and magnetically simple. AR4036, approaching the northwest limb, remains the largest group, with a large asymmetric leader. This has shown some slow decline with the umbra in the leading spot, splitting and showing signs of fading. A new region has developed in the southwest, currently only a simple Axx group, but this may have been previously numbered AR4034. The unnumbered region in the northeast appears to have numerous spots as it continues to rotate into a better viewing angle, although still appears to be magnetically simple. All other spots are small and simple at present.

Low activity is expected to continue, with a slight chance of isolated M-class flares. The greatest risk probably coming from AR4036 in the northwest, however this will rotate to the far side during this guidance period.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	20	20	15	15
Very Active	**R3-R5 (X Class)**	No	1	1	1	1

Figure 4: GOES16&18 X-ray flare trace.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc, with a reducing trend with time due to AR4036 rotating around the western limb.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	3	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux has been at background to moderate levels. With a chance of enhanced geomagnetic activity due to the HSS from CH25+ at the start of the period, the Van Allen belt is likely to suppressed away from GEO and electron flux is therefore expected to remain at background to moderate levels. However, as the geomagnetic activity wanes by the end of the period, the charged electron belts may expand back out to the location of GEO, seeing a rise in the electrons from Day 4.

Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period. MOSWOC REFM shows the electron fluence should remain below the Active threshold throughout the period, with a rising trend and is considered reasonable guidance with moderate confidence currently.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: GOES16 Electron Flux.

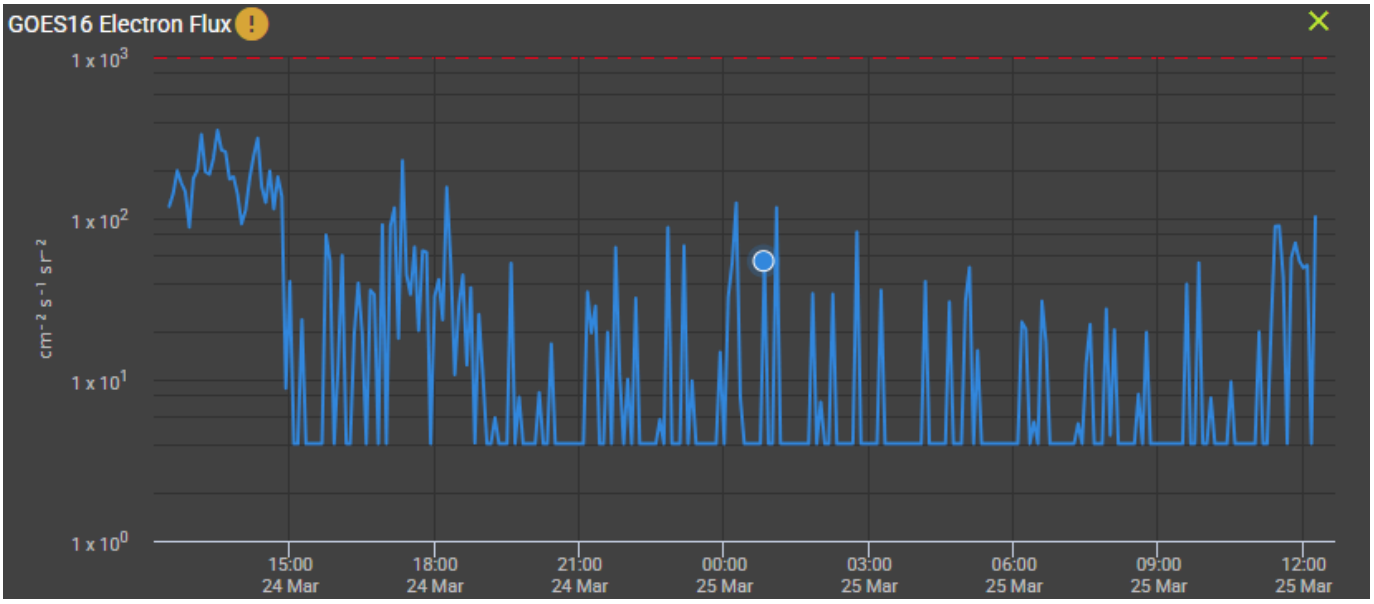

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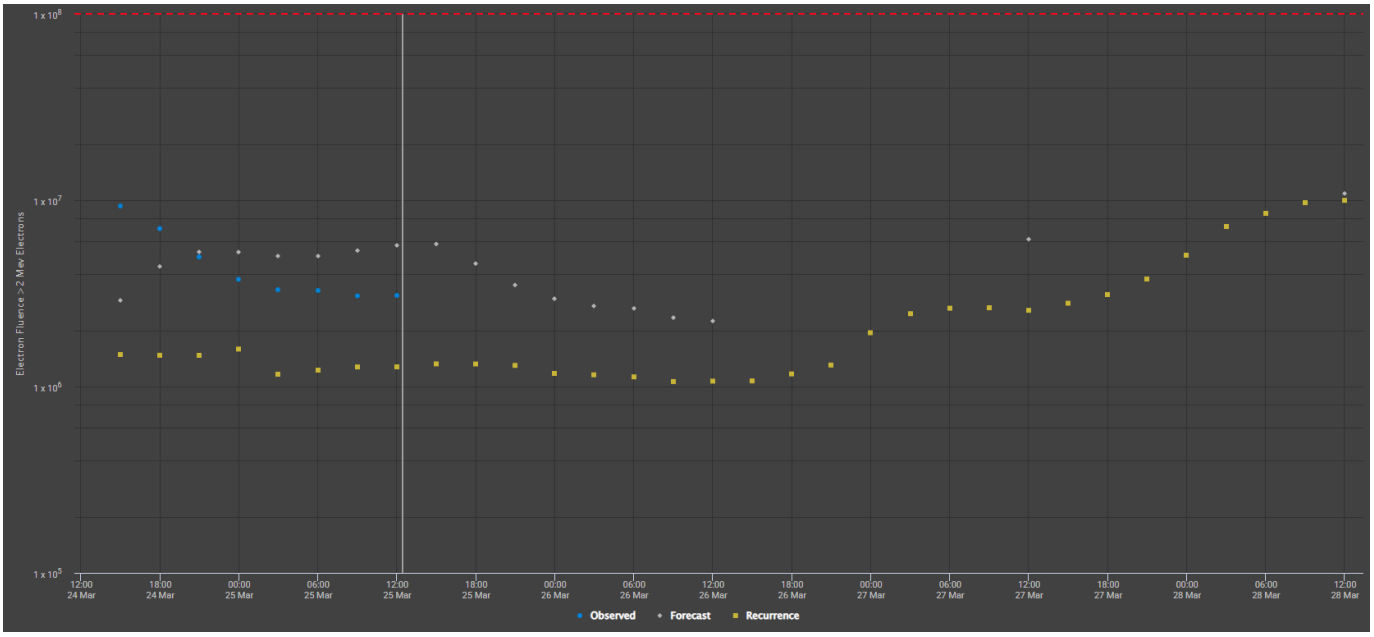
Figure 6: MOSWOC REFM output, showing a electron fluence prediction well below the active threshold initially with a slow increase towards the end of the period.



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